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THE EFFECT OF SALINE SEEP ON THE BIOTA OF FIVE RESERVOIRS IN MONTANA

by

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ABSTRACT

The effects of saline seeps on the biota of five small reservoirs in north-central Montana were studied. It was determined that the saline seeps cause increases in the amounts of TDS, conductivity, heavy metals, nutrients, chlorides and sulfates in the reservoir. The benthic fauna exhibited taxanomic changes from reservoir to reservoir. This was probably a result of the varying degrees of salinity found. The most probable cause for the elimination of fish from the reservoirs was the increase in total dissolved solids. At the time of the study the streams flowing from the study area were not affected by the saline seeps. However, the amount of salts, etc. in the streams could increase after a rainfall and be discharged to the Missouri River.

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INTRODUCTION

The Highwood Bench, located in Chouteau Country in north-central Montana, is an area beset with problems from saline seeps destroying a sizeable portion of land for agriculture. Saline seeps are areas mostly in dry cropland that are salty and wet for all or part of the year, often with salt crusts. The problem stems from the geology of the northern Great Plains where the surface material is glacial till up to 70 feet thick which is underlain by a relatively impermeable layer of marine shale. Saline seeps are formed when water from precipitation moves through the salt laden glacial till and collects on the impermeable marine shale forming a "perched" water table. The collected water then moves down slope to a swale or discharge area where it moves to the surface and evaporates leaving the characteristic salt crust (Figure 1). Saline seeps are aggravated by the crop-fallow system of agriculture used in the area. This type of dry land agriculture incorporates the practice of leaving a field fallow every other year, thereby allowing the moisture in the soil to build up. Thus, the excess moisture in the ground increases the risk of saline seeps.

At the request of the Montana Department of Health and Environmental Sciences, a biological and chemical investigation of saline seep affected farm ponds on the Highwood Bench area of Montana was conducted from June 13 to 19, 1974 by personnel from the National Field Investigations Center - Cincinnati of the U.S. Environmental Protection Agency and Region VIII EPA. The purpose of the study was to determine the effect of the saline seeps on the biota of five small reservoirs in the Highwood Bench and to ascertain whether surface waters flowing to the Missouri River are degraded by an influx of saline waters. The water bodies studied were Tunis Reservoir (used as a control and not actually situated on the Highwood Bench), Booth Reservoir, Bramlette Reservoir, Birkland Reservoir and Hanford Reservoir.

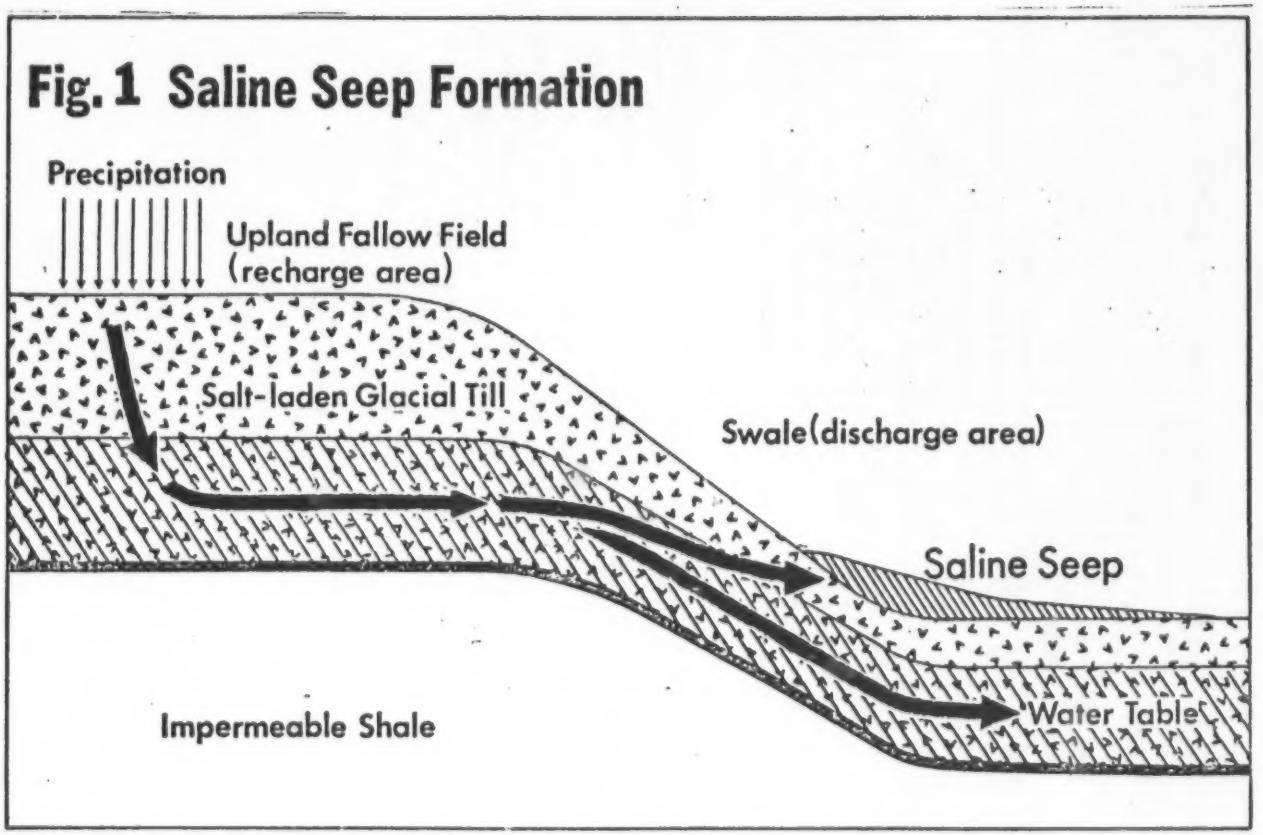


Fig. 1 Saline Seep Formation
Precipitation
Upland Fallow Field
(recharge area)
Salt-laden Glacial Till
Swale(discharge area)
Saline Seep
Water Table
Impermeable Shale

CONCLUSIONS

1. The chemical differences between Tunis Reservoir and the other reservoirs studied is quite dramatic. These changes include increases in TDS, conductivity, heavy metals, nutrients, chlorides and sulfates.

2. The chemical and biological differences between Booth Reservoir, the only reservoir to contain fish other than the control reservoir, and Bramlette Reservoir, the next more saline reservoir, were minor; indicating that the water in Booth Reservoir may be nearing the toxic level for trout.

3. The benthic fauna exhibited taxanomic changes from reservoir to reservoir. This phenomenon was probably a result of the varying degrees of salinity found.

4. Certain of the heavy metals found in the reservoirs were at levels which had previously been reported as toxic to fish. However, the extreme hardness of the reservoirs mitigate some of the toxic effect of the metals. The most probable cause for the elimination of fish from the reservoirs was the increase of total dissolved solids.

5. Unless the saline seep problem in the vicinity of Booth Reservoir can be remedied, the fish in that body of water will probably die.

6. Data obtained from creeks flowing from the study area showed them to be unaffected by the saline seeps. However, the measurements were taken after the spring flush and during a dry period. Some increase in salts, etc. could occur in these streams after a rainfall and be discharged to the Missouri River.

METHODS AND MATERIALS

In the reservoirs all quantitative benthic samples were collected in triplicate with an Ekman dredge. At most stations samples were taken at three points along a transect. The sites were labelled A, B, and C, referring to near the left bank, middle, and near the right bank of the reservoir, respectively. The left and right banks were determined as if an observer were standing on the dam looking up the reservoir. Qualitative benthic samples were taken along the shoreline from the rooted aquatic plants growing there. In the streams, qualitative samples were collected. After collection the samples were washed through a No. 30 U.S. Standard Sieve to remove the bulk of the substrate material. The sample remaining in the seive was placed in a labelled plastic jar, preserved with formaldehyde, and transported to the laboratory.

In the laboratory the benthic organisms were picked from the samples and placed in plastic petri dishes according to general groupings. Later, all organisms were identified to genus, in most cases.

Physical measurements of temperature, conductivity, dissolved oxygen and pH were obtained using a water quality monitoring system. Readings were taken at one meter intervals through the water column at each site.

Water samples for chemical analysis were taken from the surface thermocline and bottom waters at the center station of each transect. Parameters measured were ammonia, nitrite, nitrate, total kjeldhal nitrogen, soluble phosphorus, total phosphorus, total dissolved solids, chloride sulfate, sulfide, and metals. All the above analyses were run in accordance with Standard Methods for the Examination of Water and Wastewater, 13th Edition with the exception of the metals which were analyzed on an emission spectrophotometer.

RESULTS AND DISCUSSION

All data tables are contained in Appendix A. The macroinvertebrate data for the reservoirs are displayed in Tables 1 through 6. Physical data obtained from the profiling of the reservoirs are contained in Table 7. Chemical data are contained in Table 8 and metals data in Tables 9 through 12.

To facilitate matters, the findings for each reservoir will be discussed separately with a section at the end to compare the differences found in the parameters measured.

TUNIS RESERVOIR

Tunis Reservoir (Figure 2) is a small (about 10 acres), shallow (3 meters was the maximum depth found), reservoir located to the northwest of the Highwood Bench. This body of water was chosen as the control because it was unaffected by the saline seep.

Data obtained from profiling (Table 7) show a slight thermocline, low conductivity of 375-500 µmhos/cm^2, dissolved oxygen ranging from 13.0-4.1 mg/l and high pH of 9.2 to 10.4.

Chemical data obtained from samples taken during the survey (Table 8) show phosphorus and total Kjeldahl nitrogen levels in the lake at levels which could support algal growth. This probably accounts for the profuse rooted aquatic growths, which were observed at all locations in the reservoir.

Metals data from the emission spectrophotometer scan show no metals reach what is considered to be a toxic level in the reservoir (Table 9).

The State of Montana routinely stocks this reservoir with Rainbow trout which appear to be surviving well. The benthic fauna (Table 1) are typical for a small pond situation. The most prevalent taxa are Oligochaeta and the Chironomidae larvae Chironomus sp., Procladius sp., and Tanypus sp. The average number of taxa found was 9.6 per replicate and the average total number of organisms was 35,854 per m^2 per replicate. The Oligochaeta were by far the most numerous organism found ranging from 6321/m^2 at station 1 rep. 1 to 80,754/m^2 at station 2C rep. 2.

BOOTH RESERVOIR

Booth Reservoir (Figure 3), with a surface area of approximately 50 acres, was the largest of the reservoirs studied. Also it was the only other reservoir found to contain fish (Rainbow trout). The trout were stocked on a regular basis by the owner.

FIGURE 2

TUNIS RESERVOIR

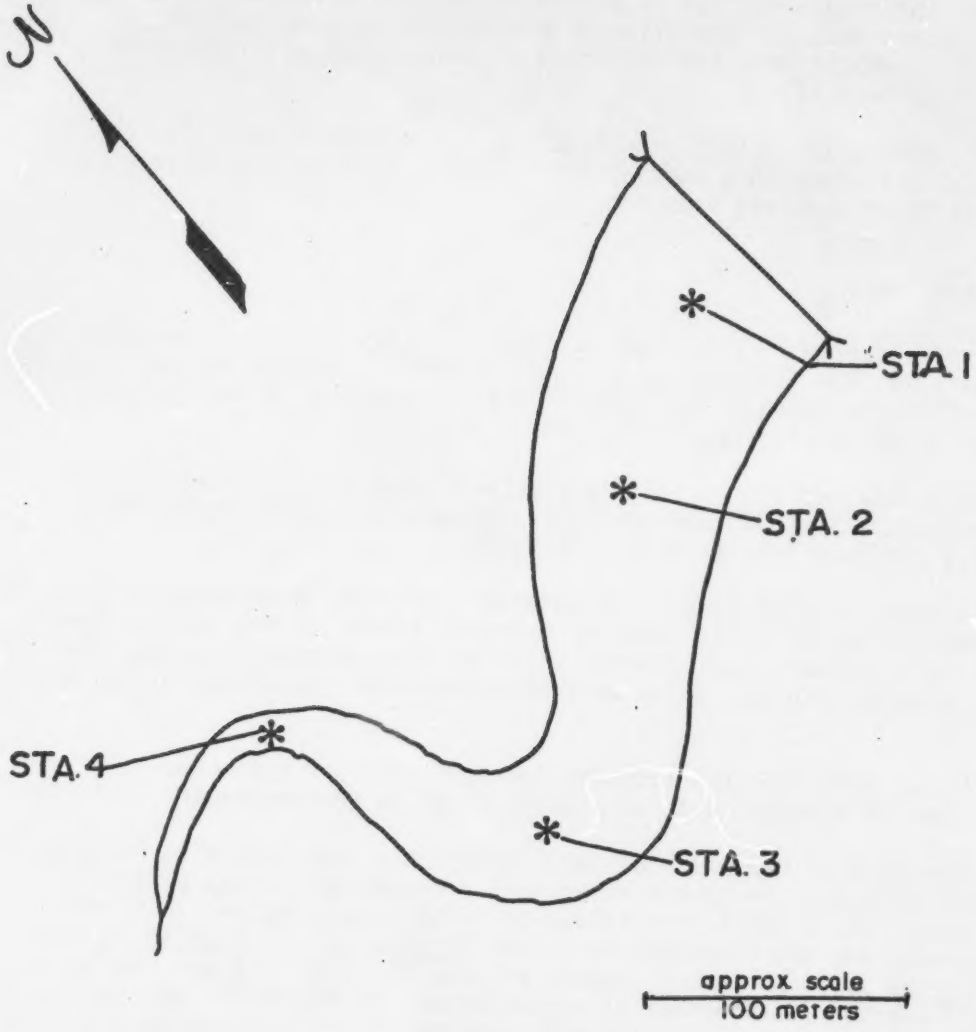
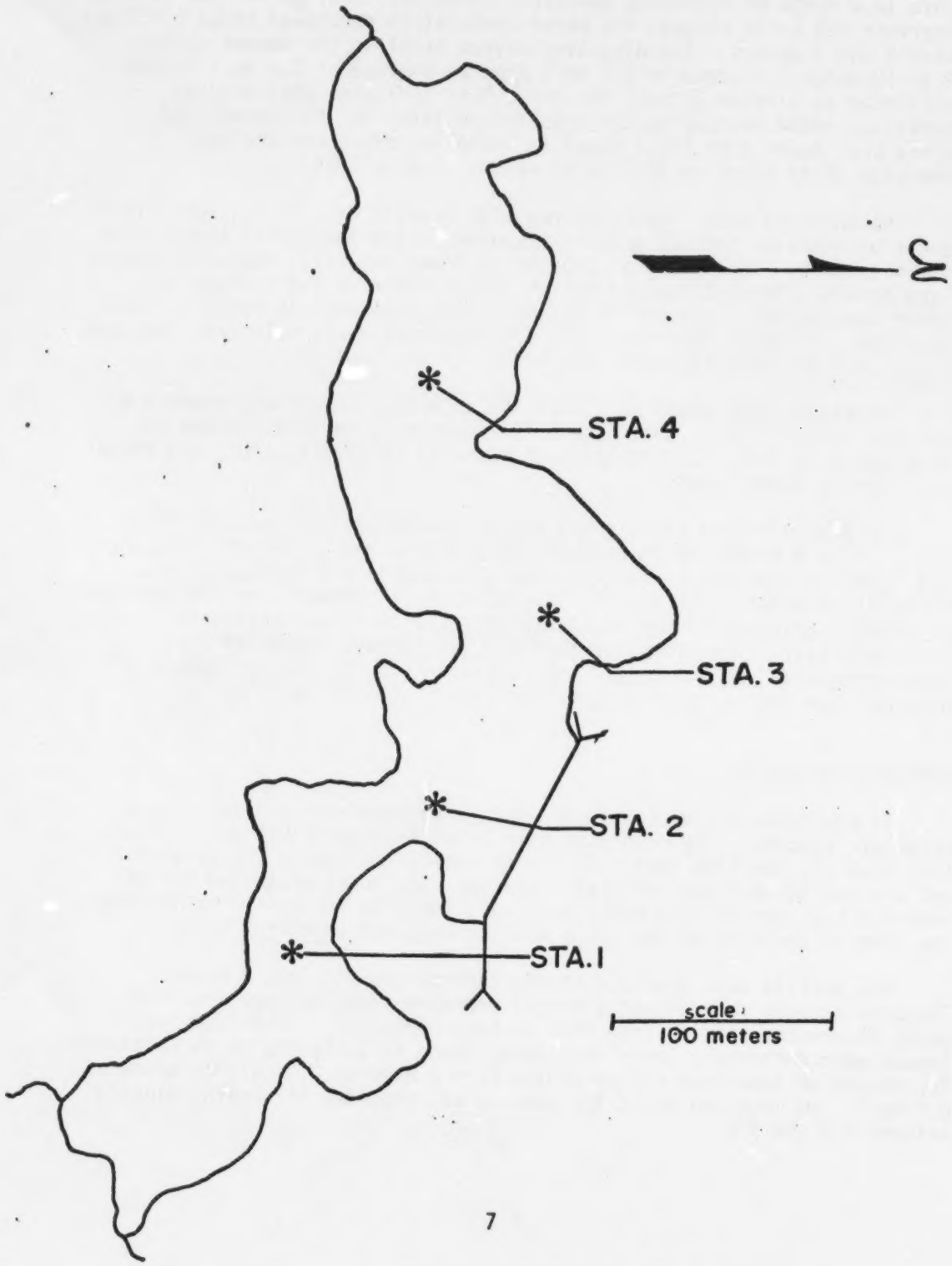


FIGURE 3

BOOTH RESERVOIR



The profuse growths of rooted aquatic plants noted in Tunis Reservoir were not found in this reservoir. Profile data showed an abrupt increase in conductivity over Tunis Reservoir from a range of 375-500 μmhos/cm^2 in Tunis to a range of 3800-5000 μmhos/cm^2 in Booth. The thermocline in this reservoir was quite strong; the water temperature decreased about 5.5°C between 5 and 7 meters. The dissolved oxygen level in the deeper waters (9 to 10 meters) dropped to 2.8 mg/l from an average of 9.1 mg/l in the epilimnion at station 3B near the dam. This indicates that anoxic conditions could develop in the hypolimnion later in the summer. pH values were lower than those found in Tunis Reservoir and are more in line with those expected in natural waters (7.8 to 8.6).

The chemical data, when compared with results from Tunis, show higher levels of Nitrogen for all species measured, while phosphorus levels were somewhat lower. The amount of phosphorus found was still ample to support algae growth. Total Dissolved Solids (TDS), chloride and sulfate all showed substantial increases in concentration from amounts found in Tunis Reservoir. In Booth Reservoir, TDS averaged 5329 mg/l, chlorides averaged 62 mg/l and sulfates averaged 3415 mg/l.

The metals data obtained (Table 10) show that magnesium, cadmium and lead all reached levels that have been reported by various sources as being toxic to fish. In addition, the amounts of nickle, zinc, and copper were nearing toxic levels.

The benthic fauna exhibited a shift in order of the most prevalent taxa. In this reservoir Chironomus sp. achieves the status of being the most numerous organism found, with the Oligochaeta and Procladius sp. following in order. The damsel flies (Zygoptera) showed a marked increase in number averaging 403 per replicate compared to 14 per replicate in Tunis Reservoir. When compared to Tunis the average number of taxa found decreased from 9.6 to 8.2 per replicate and the average number of organisms per replicate also decreased from 35,854/m^2 to 4578/m^2.

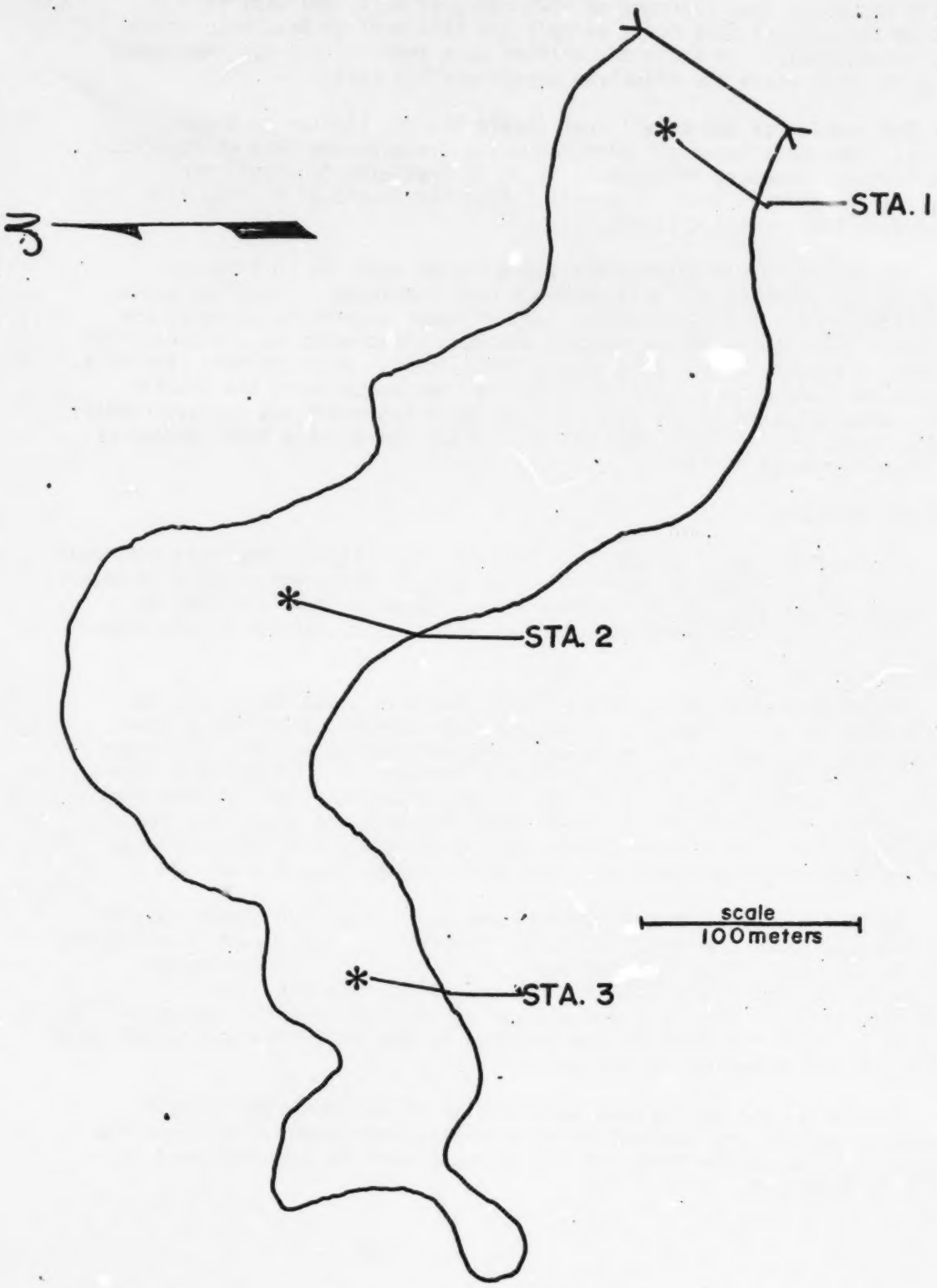
BRAMLETTE RESERVOIR

At approximately 40 years old, Bramlette Reservoir was the oldest reservoir studied. The reservoir held fish (Rainbow trout) until about 1971 when all the fish died. To try to remedy the cause, the reservoir was drained in 1972 and refilled. However, the total dissolved solids remained high and no fish would survive. The only vertebrate inhabiting the lake at the time of the study was the mudpuppy (Necturus sp.).

The profile data showed a strong thermocline at about 3 meters. The conductivity data showed a slight increase from the level found in Booth Reservoir, ranging from 4800 to 5400 μmhos/cm^2. Dissolved oxygen levels were definitely lower than those found in Tunis and Booth Reservoirs. The amount of dissolved oxygen varied from a high of 7.0 mg/l to a low of 0.0 mg/l. pH remained about the same as was recorded for Booth, ranging between 8.8 and 7.6.

FIGURE 4

BRAMLETTE RESERVOIR



The amount of nutrients, TDS, chloride and sulfate found showed an increase over levels in Booth Reservoir (Table 8). TDS, chloride and sulfate increased from averages of 5329 mg/l, 62 mg/l, and 3451 mg/l in Booth to averages of 6166 mg/l, 65 mg/l and 4458 mg/l in Bramlette reservoir, respectively. In addition, sulfide at a level of 1.0 mg/l was found at one location where the dissolved oxygen was 0.0 mg/l.

The results of the metals scan (Table 11) are similar to those obtained from Booth Reservoir with magnesium, cadmium and lead at reported toxic levels. However, the amounts found in Bramlette Reservoir are greater than those in Booth Reservoir. Also the levels of nickle, zinc, and copper were nearing toxic levels.

The benthic fauna again exhibited a change with the Chironomid Einfeldia sp. becoming the most numerous organism found. The Oligochaeta and Chironomus sp. follow in order. All of these organisms, however, are not evenly distributed throughout the samples. Procladius sp., although not the most numerous, is the most evenly distributed. Also, in this reservoir, the beetles (Coleoptera) achieve a place of prominence among the benthic fauna. When compared to the results from Tunis Reservoir the average number of taxa found per replicate declined to 5.3 and the average total number of organisms decreased to 1960/m^2.

BIRKLAND RESERVOIR

Birkland Reservoir is approximately the same size as Bramlette Reservoir (15 acres); it is, however, about twice as deep at the deepest point (9 meters). The reservoir was stocked with Rainbow trout, however, they all died in about 1971. Since that time no fish have been able to survive in the reservoir.

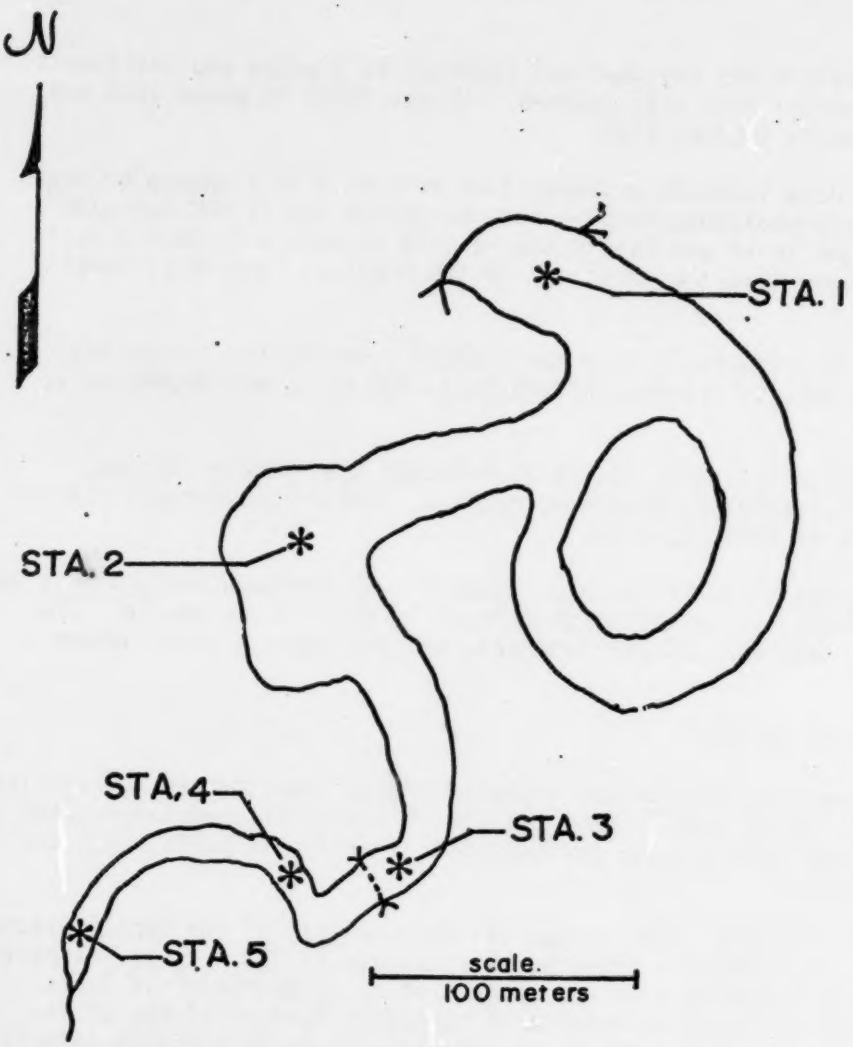
The profile data indicate that this reservoir, like those previous, thermoclined at about 3 meters. Conductivity increased over levels found in Bramlette Reservoir ranging between 5800 and 6800 µmhos/cm^2. Dissolved oxygen values showed an approximate 5 mg/l increase at 2 meters from levels found at the surface, probably because of phytoplankton layering, and zero dissolved oxygen values were obtained near the bottom at three locations in the reservoir. pH values remained at approximately the same values as found in both Booth and Bramlette Reservoirs ranging from 8.9 to 8.2.

Again the values for the chemical analyses in Table 8 showed substantial increases over previously discussed reservoirs. The amount of nutrients found in the water column was extremely high (Table 8). TDS averaged 7724 mg/l, chloride nearly doubled from previously recorded levels in the other reservoirs to 123 mg/l, and sulfate averaged 5658 mg/l. Also a sulfide value of 1.7 mg/l was found at one location in the reservoir, again associated with a 0.0 mg/l dissolved oxygen value.

Results of the metals scan were similar to previous results with magnesium, cadmium and lead achieving possibly toxic levels. However, the amounts of these metals found did not increase over the amounts found in Bramlette Reservoir.

FIGURE 5

BIRKLAND RESERVOIR



The benthic fauna was dominated by Chironomus sp. with Glyptotendipes sp. and Oligochaeta making up most of the other organisms found. Also the Amphipod Hyalella sp. was in large numbers at selected stations. The average number of taxa per replicate was 9.9 and the average total number of organisms was 2793/m^2.

HANFORD RESERVOIR

Hanford Reservoir was the smallest (about 1 to 2 acres and shallowest (2 meter maximum depth) reservoir studied. It was built in about 1966 and has never been able to support fish.

The profile data indicate a thermocline between 1 to 2 meters of depth. Conductivity was extremely high ranging between 28,000 and 32,000 µmhos/cm^2. The dissolved oxygen level was fairly low ranging between 4.8 and 5.2 mg/l. pH was somewhat lower than that recorded in the previous reservoirs ranging between 8.1 and 8.4.

Nutrient values (Table 8) were the highest recorded for the survey. TDS, chloride and sulfate averaged 57,950 mg/l, 303 mg/l, and 45,650 mg/l, respectively.

Data from the metals scan (Table 9) indicate that nickle, chrome, magnesium, arsenic, vanadium, aluminum, cadmium, lead and copper all reached levels which could be toxic to fish.

The major organism found in this reservoir was the Amphipod Hyalella sp. The most that can be said of the benthic fauna is that it was sparse. The average number of taxa was 1.7 per replicate and the average total number was 258/m^2.

SHONKON AND HIGHWOOD CREEKS

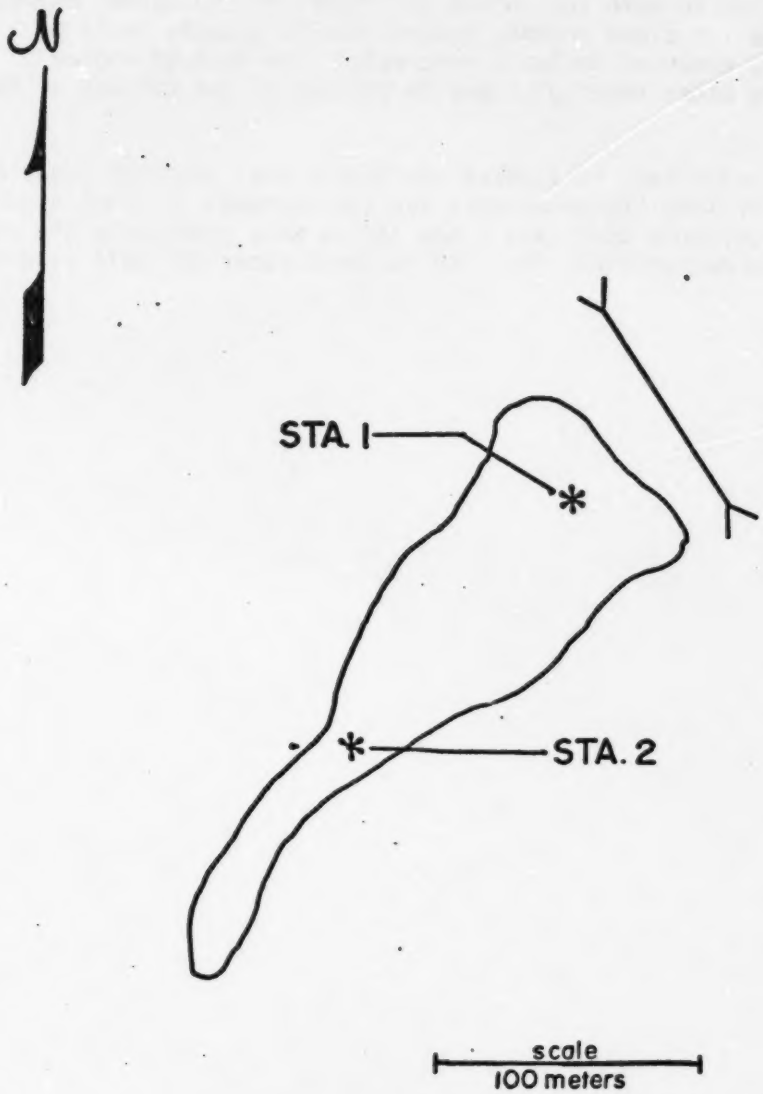
Data obtained from Shonkon and Highwood Creeks show them to be relatively unaffected by the saline seeps. However, the measurements were taken after the spring flush and during a dry period. Some increase in salts, etc. could occur after a rainfall.

In general, the data show the quality and quantity of the benthic fauna in the reservoir are adversely affected by increases in TDS. It is interesting to note that the Oligochaeta attained numbers of up to 80,754/m^2 in Tunis Reservoir, but was not found in numbers of more than 4214/m^2 in any of the other reservoirs; indicating that the Oligochaeta, although normally associated with pollution, are adversely affected by high total dissolved solids. The average number of taxa found per replicate was also the greatest in Tunis reservoir, indicating that the diversity of the benthos is also adversely affected by high TDS.

The Chironimidae, as a group, exhibit the least effect from high salinity. Although the total numbers and most numerous taxon vary from reservoir to

FIGURE 6

HANFORD RESERVOIR



reservoir, they were the most abundant group of organisms found in all of the reservoirs, except Tunis.

While several heavy metals in the saline affected reservoirs reached levels which have been reported as toxic to fish, the hardness of the water in these water bodies probably negated the toxic effect of the metals.

It is interesting to note that while all reservoirs contained amounts of nutrients adequate for algae growth, rooted aquatic plants, in large quantities, were only observed in Tunis reservoir. The lack of rooted aquatic plants in the other reservoirs may be because of the effects of the saline seep.

From the data collected, it appears the single most probable cause of the extinction of fish from the reservoirs was the increase in total dissolved solids. It is also probable that unless the saline seep problem in the vicinity of the Booth farm can be remedied, the fish in Booth reservoir will also die out.

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APPENDIX A

TABLE 1

TURIS RESERVOIR
MONTANA
6/19/74

Station No.	1			2A			2B			2C			2D	3			3
Depth	3m			2.5m			3m			1.5m			Qual	2m			Qual
Replicate No.	1	2	3	1	2	3	1	2	3	1	2	3	1	1	2	3	1
Organisms																	
Amphipoda																	
Hyalella sp.	731		43		43	129	43			86		43	Q			43	Q
Polmonata																	
Physa sp.										86			Q			43	Q
Helisoma sp.	43	43		129	86		43			172			Q	258		86	Q
Diptera																	
Chironomidae																	
Chironomus sp.	4644	3956	3956	3269	1419	2150	4472	2924	3913	989	301	215		645	301	473	
Cricotopus sp.		86															
Einfeldia sp.		43	86	43	43		86		43								
Eukiefferiella sp.			86		43												
Glyptotendipes sp.	43				43	43										43	
Heterotissocladius sp.										86							Q
Orthocladius sp.						129											
Procladius sp.	172	344	645	645	731	344	1032	1247	1720	387	258	43		301	215		
Tanypus sp.		387	301	731	473	472	258	301	215	86	43	86		1204	1376	1720	
Tanytarsus sp.					43												Q
Tissocladius sp.	129																
Culicidae																	
Chaoborus sp.	516	215				129	86					43			43		
Ceratopogonidae																	
Bezzia sp.	86	129	215	129	301	344	129	172	215		516	516		129	43	172	Q
Antomvidae																	
Limnophora sp.													Q				
Ephemeroptera																	
Baetidae										43						43	
Aneletus sp.													Q				Q
Caenis sp.		129	129			86				86	86						Q
Zygoptera																	
Coenargionidae	86												Q				
Enallagma sp.			43			43							Q				
Ischnura sp.			43										Q				Q
Lestidae																	
Lestes sp.													-				Q
Hemiptera																	
Corixidae											172						Q
Hydracarina		43	86	129	43			86		43			Q				
Coleoptera																	
Dytiscidae																	
Hydroporus sp.																	Q
Dytiscus sp.													Q				
Helodidae																	
Cyphron sp.																	Q
Curculionidae																	Q
Haliplidae																	
Haliplus sp.													Q				
Oligocheata	6321	12855	10879	17630	27778	31691	15394	14491	21328	51944	80754	66005	Q	40033	55556	21328	Q
Hirudinea		43	473		344				301	172	172	172		43	43	1935	Q
Nematoda																	
Number/m^2	12900	18273	16985	22834	31390	35566	21543	19221	27735	54782	82302	67123	Qual	42699	57577	25885	Qual
Number of Taxa	10	12	13	9	13	11	9	6	7	14	8	8	12	8	7	10	17

TABLE 2

BOOTH RESERVOIR
MONTANA
6/19/74

Station No.	1A			1B			1C			1D
Depth	4m			4m			3m			Qual
Replicate No.	1	2	3	1	2	3	1	2	3	1
Organisms										
Amphipoda										
Hyalella sp.		215	688	2365	516	301	1892	2666	2967	Q
Pulmonaia										
Physa sp.				129			129		946	
Helisoma sp.							172	43	473	
Diptera										
Chironimidae										
Ablabesmyia sp.		258	43	129	215	129	86	172	172	
Chironomus sp.	1161	473	1978	5590	4171	3870	2064	2064	2236	Q
Cryptochironomus sp.										
Einfeldia sp.	516		774	903	86	129	86	774	172	
Eukiefferiella sp.										
Glyptotendipes sp.	430	43	989	516	301	430	1118	731	1247	
Psectrocladius sp.										
Polypedilum sp.										
Procladius sp.	989	129	387	387			516	172	43	Q
Tanypus sp.		43								Q
Tanytarsus sp.		43	43							
Tissocladius sp.										Q
Pupae			86	86	86	43	86	129		
Culicidae										
Cnaoborus sp.		344				430				
Ceratopogonidae										
Bezzia sp.										
Ephemeroptera										
Beatidae		43			43		43	43		
Ameletus sp.										Q
Tricoptera										
Lepidoceridae								43		
Leptocella sp.				43	43			43		
Limnephilidae										
Limnephilus sp.			86							Q
Phryganeidae										
Phryganea sp.										
Zygoptera										
Coenargionidae	43	860	688	1161	215	258	430	903	1032	
Enallagama sp.		86		215	344	172		43		Q
Ishnura sp.					43				43	Q
Hemiptera										
Corixidae	86									
Coleoptera										
Dytiscidae										
Hydroporus sp.										
Haliplidae										
Haliplus sp.										
Oligocheata	731	344	5848	1032	1849	817	3999	4214	4644	Q
Hirudinea						43				
Number/m^2	3956	2881	11610	12556	7912	6622	10535	12384	13975	Qual
Number of Taxa	7	12	11	12	12	11	12	14	11	10

Table 2 - continued

Station No.	2A			2B			2C			2D
Depth	6m			10m			5m			Qual
Replicate No.	1	2	3	1	2	3	1	2	3	1
Organisms										
Amphipoda										
Hyalella sp.		774	43		43			215	215	Q
Pulmonata										
Physa sp.		43							43	Q
Helisoma sp.							86	129	129	Q
Diptera										
Chironimidae										
Ablabesmyia sp.		86		43	43		43	43	172	Q
Chironomus sp.	43	258	387	1247	1849	989	344	86	43	
Cryptochironomus sp.		43								
Einfeldia sp.	43	129		129		172			129	
Eukiefferiella sp.							86			
Glyptotendipes sp.	43	946	129	43		86			172	Q
Psectrocladius sp.										Q
Polypedilum sp.	43	43								
Procladius sp.	946	1247	559	559	688	860		129	86	
Tanypus sp.						43				
Tanytarsus sp.										Q
Tissocladius sp.										
Pupae				129	43			43		
Culicidae										
Chaoborus sp.				43			86	43		
Ceratopogonidae										
Bezzia sp.		86								Q
Ephemeroptera										
Beatidae						43				
Ameletus sp.										Q
Tricoptera										
Leptoceridae		43						43		
Leptocella sp.							43			Q
Limnephilidae										
Limnephilus sp.										
Phryganeidae										
Phryganea sp.		43							43	
Zygoptera										
Coenargionidae		1247		172		43	774	387	1548	
Enallagma sp.		86					43		43	Q
Ishnura sp.										
Hemiptera										
Corixidae										
Coleoptera										
Dytiscidae										
Hydroporus sp.										
Haliplidae										
Haliplus sp.										
Oligocheata		1849	301				301	215		
Hirudinea										
Number/m^2	1118	6923	1419	2365	2666	2236	1806	1333	2623	Qual
Number of Taxa	5	15	5	8	5	7	9	10	11	11

Table 2 - continued

Station	3A			3B			3C			3D
Depth	8m			10m			9m			Qual
Replicate	1	2	3	1	2	3	1	2	3	1
Organisms										
Amphipoda										
Hyalella sp.				43						Q
Pulmonaia										
Physa sp.										
Helisoma sp.			43							
Diptera										
Chironimidae										
Ablabesmyia sp.				172	129					Q
Chironomus sp.	129		215	2107	2107	1376	1591	688	129	
Cryptochironomus sp.		43							43	
Einfeldia sp.	817	1333			43	129			43	
Eukiefferiella sp.										
Glyptotendipes sp.	86		989			430	430	129		Q
Psectrocladius sp.										Q
Polypedilum sp.										
Procladius sp.	1419	1462	45	774	602	1032	774	129	387	
Tanypus sp.										
Tanytarsus sp.										Q
Tissocladius sp.										
Pupae		129								
Culicidae										
Chaoborus sp.			43	129	129	43				
Ceratopogonidae										
Bezzia sp.										
Ephemeroptera										
Beatidae										
Ameletus sp.										Q
Tricoptera										
Leptoceridae										
Leptocella sp.			172							
Limnephilidae										
Limnephilus sp.										
Phryganeidae										
Phryganea sp.										
Zygoptera										
Coenargionidae										Q
Enallagama sp.										Q
Ishnura sp.										Q
Hemiptera										
Corixidae										
Coleoptera										
Dytiscidae										
Hydroporus sp.										
Haliplidae										
Haliplus sp.										
										Q
Oligocheata	86	86	43					43	43	Q
Hirudinea										
Number/m^2	2537	3053	2451	3225	3010	3010	2795	989	645	Qual
Number of Taxa	5	5	7	5	5	5	3	4	6	11

Table 2 - continued

Station No.	4A			4B			4C			4D
Depth	3m			4m			4m			Qual
Replicate No.	1	2	3	1	2	3	1	2	3	1
Organisms										
Amphipoda										
Hyalella sp.		817		43	645	129		602	430	Q
Pulmonata										
Physa sp.					86	86				Q
Helisoma sp.			43	86	43		86			Q
Diptera										
Chironimidae										
Ablabesmyia sp.		387	43	215	473	602	43	473	129	Q
Chironomus sp.	4773	6493	3569	6579	5461	4257	1806	5805	2365	
Cryptochironomus sp.										
Einfeldia sp.	430	43	387	129	129	43				Q
Eukiefferiella sp.										
Gyptotendipes sp.	430	430	645			129		86		Q
Psectrocladius sp.										
Polypedilum sp.										
Procladius sp.	688	504	860						43	Q
Tanypus sp.										
Tanytarsus sp.										Q
Tissocladius sp.										Q
Pupae	387	129	387	43	129	86		344	43	
Culicidae										
Chaoborus sp.				43			86		129	
Ceratopogonidae										
Bezzia sp.	43								172	?
Ephemeroptera										
Beatidae										
Ameletus sp.					43	129		43		
Tricoptera										
Leptoceridae										
Leptocella sp.	43									Q
Limnephilidae										Q
Limnephilus sp.										
Phryganeidae										
Phryganea sp.					43					
Zygoptera										
Coenargionidae										
Enallagama sp.		86		43	172			172		Q
Ishnura sp.					86	86		172	129	Q
				43						Q
Hemiptera										
Corixidae										Q
Coleoptera										
Dytiscidae										
Hydroporus sp.										
Haliplidae										Q
Haliplus sp.										
									43	
Oligocheata	1118	387	473	129	645	86				Q
Hirudinea										Q
Number/m^2	7972	9288	6407	7224	7921	5633	2236	7869	3526	Qual
Number of Taxa	8	9	8	10	12	10	5	9	9	19

TABLE 3

BRAMLETTE RESERVOIR
MONTANA
6/13/74

Station No.	1A			1B			1C			1D
Depth	4.5m			5m			4.5m			Qual
Replicate No.	1	2	3	1	2	3	1	2	3	1
Organisms										
Amphipoda										
Hyalella sp.										Q
Diptera										
Chironomidae										
Ablabesmyia sp.										
Chironomus sp.		129	129				86			
Cricotopus sp.										
Cryptochironomus sp.		43		43			43			
Einfeldia sp.									43	
Glyptotendipes sp.										
Paratanytarsus sp.										
Procladius sp.	688	559	559	172	301	129	516	172	86	
Psectrocladius sp.					86		43			
Psectrotanypos sp.			43							
Tanypus sp.		43		86	129				129	
Tanytarsus sp.						86				
Tissocladius sp.						43				
Culicidae										
Chaoborus sp.					43					
Ceratopogonidae										
Bezzia sp.					43		43			
Tabanidae										
Chrysops sp.										
Ephemeroptera										
Beatidae										
Ameletus sp.										
Tricoptera										
Leptoceridea										
Arthripsodes sp.										
Leptocella sp.										
Oecetis sp.										
Zygoptera										
Coenargionidae								43		
Enallagama sp.										
Ishnura sp.										
Coleoptera										
Haliplidae										
Haliplus sp.										
Dydtiscidae										
Hydroporus sp.										
Rhantus sp.										
Oligochaeta										
Number/m^2	688	774	731	301	602	258	731	215	258	Qual
Number of Taxa	1	4	3	3	5	3	5	2	3	1

Table 3 - continued

Station No.	2A			2B			2C			2D
Depth	2m			3.5m			3.5m			Qual
Replicate	1	2	3	1	2	3	1	2	3	1
Organisms										
Amphipoda										
Hyalella sp.		43	43		129					Q
Diptera										
Chironomidae										
Ablabesmyia sp.		43								Q
Chironomus sp.			43	43	43		86			
Cricotopus sp.								86		
Cryptochironomus sp.										
Einfeldia sp.		86		86		43	5848	5160	5074	Q
Glyptotendipes sp.				172	86					
Paratanytarsus sp.						43				
Procladius sp.		43	86	43	387	43	129	215	258	
Psectrocladius sp.		43	129							
Psectrotanypos sp.										
Tanypus sp.										
Tanytarsus sp.			43		129		43			
Tissocladius sp.										Q
Culicidae										
Chaoborus sp.										
Ceratogpogonidae										
Bezzia sp.		43					301	129	172	
Tabanidae										
Chrysops sp.	43									Q
										Q
Ephemeroptera										
Beatidae										
Ameletus sp.										
Tricoptera										
Leptoceridea										
Arthripsodes sp.					43	43		86		Q
Leptocella sp.	43	129			86	43		86	43	Q
Oecetis sp.							129			
Zygoptera										
Coenargionidae										Q
Enallagama sp.										Q
Ishnura sp.			43							
Coleoptera										Q
Haliplidae										
Haliplus sp.							43			
Dydtiscidae										
Hydroporus sp.		43								
Rhantus sp.										
Oligochaeta	602	344	1505	301		1161	1290	903	516	Q
Number/m^2	688	817	1896	645	903	1505	7826	6665	6106	Qual
Number of Taxa	3	9	7	5	7	7	7	7	6	12

Table 3 - continued

Station No.	3A			3B			3C			3D
Depth	2.5m			3m			1m			Qual
Replicate	1	2	3	1	2	3	1	2	3	1
Organisms										
Amphipoda										
Hyalella sp.			129		344					Q
Diptera										
Chironomidae										
Ablabesmyia sp.		86		688	602	43		43	43	Q
Chironomus sp.	43		43	43	129		1247	1839	3569	Q
Cricotopus sp.					43					
Cryptochironomus sp.										
Einfeldia sp.				215	86	43		86	86	Q
Glyptotendipes sp.					86					
Paratanytarsus sp.					43					
Procladius sp.					86					
Psectrocladius sp.					129		1806	430		
Psectrotanypos sp.										
Tanypus sp.			43							
Tanytarsus sp.		43		215				86	43	Q
Tissocladius sp.									989	Q
Culicidae										
Chaoborus sp.										
Ceratopogonidae										
Bezzia sp.	43	215		258	215	129				
Tabanidae										
Chrysops sp.										
Ephemeroptera										
Beatidae										
Ameletus sp.										?
Tricoptera										
Leptoceridea										
Arthripsodes sp.										
Leptocella sp.			86							
Oecetis sp.					43					
Zygoptera										
Coenargionidae										
Enallagama sp.				258	774	43	43			
Ishnura sp.					43					Q
										Q
Coleoptera										
Haliplidae										
Haliplus sp.	43	43	43	1505	1892	430				
Dydtiscidae										
Hydroporus sp.										
Rhantus sp.										Q
										Q
Oligochaeta			172		43	86	215	43	516	
Number/m^2	129	387	516	3182	4558	1462	3311	2537	5246	Qual
Number of Taxa	3	4	6	7	15	6	4	6	6	11

TABLE 4

BIRKLAND RESERVOIR
MONTANA
6/17-18/74

Station No.	1A			1B			1C			1D	2A			2B			2C		
Depth	7.5m			9m			4m			Qual	1.5m			2m			6m		
Replicate No.	1	2	3	1	2	3	1	2	3	1	1	2	3	1	2	3	1	2	3
Organisms																			
Amphipoda																			
Hyallella sp.	43		43	43			86		86	Q	2537	2838	1376		86			43	
Pulmonata																			
Physa sp.											86	43			86	86			
Diptera																			
Chironomidae			43																
Ablabesmyia sp.			43		43		86	43	43	Q	301	86		43	129	172			
Cardiocladius sp.																			
Chironomus sp.		215		129	129	215	301	2150	2021	Q	1763	1720	602	3741	2537	5246	1860	2666	6321
Conchapelopia sp.																			
Cricotopus sp.																			
Dicotendipes sp.								43											
Einfeldia sp.																			
Eukiefferiella sp.																			
Glyptotendipes sp.							344		473		2709	301		430	1849	1462		43	
Goeldichironomus sp.															43				
Parametriocnemus sp.																		43	
Procladius sp.							43	43											
Psectrotanypus sp.																			
Tanypus sp.			43				387	86											
Tissocladius sp.																			
Ceratopogonidae																			
Bezzia sp.																			
Ephyridae																			
Ephyra sp.										Q									
Tabanidae																			
Chrysops sp.										Q									
Zygoptera																			
Coenargionidae						43					129	127	129						43
Coenagion sp.								43											
Enallagama sp.								43		Q	258	86	129	129	129	43			43
Ishnura sp.							43			Q									
Hemiptera																			
Corixidae		43																	
Notonectidae																			
Coleoptera																			
Haliplidae																43			43
Haliplus sp.																			
Hydrophilidae																			
Enochus sp.																	43		
Hydrochus sp.																			
Oligocheata							344	43		Q	774	602	301	688	301	344			
Number/m^2	43	258	215	172	172	258	1548	2537	2623	Qual	8557	5803	2537	5031	5160	7396	1903	2838	6450
Number of Taxa	1	2	4	2	2	2	8	8	4	7	8	9	5	5	8	7	2	4	4

Table 4 - continued

Station No.	3			4			4	5		
Depth	3m			1.5m			Qual	1m		
Replicate No.	1	2	3	1	2	3	1	1	2	3
Organisms										
Amphipoda										
Hyallela sp.	86				43	43	Q	1376	989	344
Pulmonata										
Physa sp.			43			43	Q		43	
Diptera										
Chironomidae										
Ablabesmyia sp.			127			172		43		
Cardiocladius sp.										
Chironomus sp.	688	43	2064	602	512	1849		5977	817	127
Conchapelopia sp.	43					43				
Cricotopus sp.							Q			
Dicotendipes sp.										
Einfeldia sp.								43		
Eukiefferiella sp.							Q		903	
Glyptotendipes sp.	86		1161			731				
Goeldichironomus sp.										
Parametriocnemus sp.				43			Q			
Procladius sp.	43									
Psectrotanypus sp.									43	
Tanypus sp.	645		43			172				
Tissocladius sp.								86		86
Ceratopogonidae										
Bezzia sp.							Q			127
Ephyridae										
Ephyra sp.							Q			
Tabanidae										
Chrysops sp.										
Zygoptera										
Coenargionidae	258									
Coenagion sp.	43						Q			
Enallagama sp.										
Ishnura sp.	172					43	Q		86	
Hemiptera										
Corixidae							Q			
Notonectidae							Q			
Coleoptera										
Haliplidae										
Haliplus sp.	43									
Hydrophilidae										
Enochus sp.							Q			
Hydrochus sp.										
Oligocheata	129		516	43		129			43	43
Number/m^2	2236	43	3954	774	559	3225	Qual	7525	2924	727
Number of Taxa	11	1	6	3	2	9	13	5	7	5

TABLE 5

HANFORD RESERVOIR
MONTANA
6/17/74

Station No.	1			2			2
Depth	2m			1m			Qual
Replicate No.	1	2	3	1	2	3	1
Organisms							
Amphipoda							
Hyalella sp.		215	602			43	
Diptera							
Chironimidae		86					
Tanypus sp.			172				
Cricotopus sp.			129			43	
Tissocladius sp.							Q
Ceratopogonidae							
Bezzia sp.			43				
Ephemeroptera							
Beatidae							
Ameletus sp.	129						
Zygoptera							
Coenargionidae							
Enallagama sp.							Q
Oligocheata			86				
Total number	129	301	1032	0	0	86	Qual
Number of Taxa	2	2	4	0	0	2	2

TABLE 6

MONTANA SALINE SEEP
6-20-74

Organisms	Highwood Creek	Shonkon Creek
Amphipoda		
Hyalella sp.		Q
Diptera		
Chironimidae		
Cricotopus sp.		Q
Heterotisocladius sp.	Q	
Ceratopogonidae		
Bezzia sp.	Q	
Simulidae		
Simulium sp.	Q	Q
Ragionidae		
Atherix sp.	Q	
Ephemoroptera		
Baetidae		
Ameletus sp.	Q	
Baetis sp.	Q	Q
Isonychia sp.		
Pseudochoeon sp.	Q	
Siphionurus sp.	Q	
Tricorythodes sp.	Q	
Heptageniidae		
Heptagenia sp.		Q
Tricoptera		
Hydropsychidae		
Cheumatopsyche sp.	Q	
Leptoceridae		
Athripsodes sp.	Q	
Odonata		
Anisoptera		
Aeshna sp.		Q
Zygoptera		
Coenagrion sp.		Q
Hemiptera		
Corixidae	Q	
Naucoidae		
Pelocyoris sp.	Q	
Ambrysus sp.		Q
Coleoptera		
Elmidae		
Optioservus sp.	Q	
Oligochaeta		Q
Number/m^2	Qual	Qual
Number of Taxa	14	10

TABLE 7

MONTANA SALINE SEEP

6/74

STATION PROFILES

Reservoir	Station No. and Depth (m)	Date	Temperature (°C)	Conductivity µmhos/cm²	Dissolved Oxygen (mg/l)	pH
Tunis	1	6/19/74				
	0		22.0	450	10.3	9.9
	1		22.0	450	10.1	9.9
	2		21.0	400	13.2	9.9
	3		20.0	400	9.8	9.9
	2A	6/19/74				
	0		22.5	450	10.2	10.1
	1		22.0	425	8.6	10.0
	2		21.5	400	10.0	10.0
	2.5		20.5	400	7.0	9.6
	2B	6/19/74				
	0		22.5	450	11.6	10.2
	1		22.5	450	9.7	10.0
	2		22.0	425	10.8	9.9
	3		20.0	375	5 4	9.2
	2C	6/19/74				
	0		23.5	450	13.0	10.2
	1		23.0	450	11.2	10.1
	1.5		23.0	425	8.2	9.8
	3	6/19/74				
	0		25.0	500	12.0	10.4
	1		24.0	475	10.8	10.4
	1.5		22.0	400	4.1	9.8

Table 7 (con't.)

Reservoir	Station No. and Depth (m)	Date	Temperature (C°)	Conductivity µmhos/cm²	Dissolved Oxygen (mg/l)	pH
Booth	1A	6/15/74				
	0		18.5	4500	10.8	8.6
	1		18.5	4500	10.8	8.6
	2		18.5	4500	10.8	8.6
	3		17.5	4400	10.0	8.4
	4		16.0	4200	8.8	8.3
	1B	6/15/74				
	0		21.0	4500	9.8	8.6
	1		20.0	4600	10.1	8.6
	2		19.0	4500	10.2	8.5
	3		18.0	4300	9.5	8.4
	3.5		17.0	4200	9.5	8.4
	1C	6/15/74				
	0		19.0	4500	10.0	8.6
	1		18.5	4500	10.0	8.5
	2		18.0	4400	10.4	8.5
	3		17.0	4300	10.4	8.4
	2A	6/16/74				
	0		20.0	4800	10.0	8.6
	1		19.5	4700	10.2	8.6
	2		19.0	4600	9.2	8.6
	3		19.0	4600	10.4	8.5
	4		18.5	4600	9.6	8.5
	5		17.0	4200	8.6	8.3
	6		13.5	4000	5.8	8.0
	2B	6/16/74				
	0		21.0	4800	10.0	8.6
	1		20.5	4700	9.4	8.6
	2		20.0	4600	9.6	8.6

Table 7 (con't)

Reservoir	Station No. and Depth (m)	Date	Temperature (Co)	Conductivity µmhos/cm^2	Dissolved Oxygen (mg/l)	pH
Booth (con't.)	2B	6/16/74				
	3		19.5	4600	9.9	8.5
	4		19.0	4500	9.7	8.5
	5		17.5	4400	8.6	8.3
	6		15.5	4100	5.2	7.9
	7		12.5	4000	5.1	7.9
	8		11.0	3900	4.4	7.9
	9		10.0	3900	4.0	7.8
	10		10.0	3800	3.3	7.8
	2C	6/16/74				
	0		22.0	4800	9.0	8.6
	1		21.0	4700	9.6	8.6
	2		20.0	4500	9.2	8.6
	3		19.5	4500	9.3	8.5
	4		19.0	4500	9.8	8.5
	5		17.0	4200	7.6	8.3
	3A	6/16/74				
	0		22.0	4900	9.0	8.6
	1		22.0	4800	8.7	8.6
	2		21.0	4700	9.0	8.6
	3		20.0	4600	9.2	8.5
	4		19.5	4500	9.4	8.5
	5		17.5	4300	7.6	8.3
	6		15.0	4100	4.8	7.9
	7		12.0	4000	4.6	7.9
	8		11.0	4000	4.3	7.9
	3B	6/16/74				
	0		23.5	5000	8.1	8.6
	1		22.0	4800	10.0	8.6
	2		21.0	4600	8.8	8.5

Table 7 (con't)

Reservoir	Station No. and Depth (m)	Date	Temperature (C^0)	Conductivity $\mu mhos/cm^2$	Dissolved Oxygen (mg/l)	pH
Booth (con't.)	3B	6/16/74				
	3		20.0	4600	9.3	8.5
	4		19.0	4500	9.4	8.5
	5		18.0	4300	8.1	8.2
	6		15.0	4100	4.3	7.9
	7		12.0	4000	4.4	7.9
	8		11.0	3900	4.2	7.8
	9		10.0	3900	2.8	7.8
	10		9.5	3800	2.8	7.8
	3C	6/16/74				
	0		22.5	5000	9.8	8.6
	1		22.0	5000	9.6	8.6
	2		21.0	4800	9.3	8.6
	3		20.0	4700	9.6	8.5
	4		19.5	4600	9.6	8.5
	5		17.5	4400	8.0	8.3
	6		15.0	4200	5.3	8.0
	7		12.0	4000	4.8	7.9
	8		11.0	4000	4.2	7.9
	9		10.0	4000	3.6	7.9
	4A	6/15/74				
	0		21.0	4800	10.2	8.6
	1		21.0	4800	10.0	8.6
	2		21.0	4800	10.0	8.6
	3		21.0	4800	10.0	8.6
	4B	6/15/74				
	0		21.0	4800	10.4	8.6
	1		20.5	4800	9.5	8.6
	2		20.5	4800	9.8	8.6
	3		20.5	4800	9.5	8.6
	4		20.5	4800	9.8	8.5

Table 7 (con't)

Reservoir	Station No. and Depth (m)	Date	Temperature (C°)	Conductivity µmhos/cm²	Dissolved Oxygen (mg/l)	pH
Booth (con't.)	4C	6/15/74				
	0		21.0	4700	10.2	8.6
	1		21.0	4700	9.8	8.6
	2		20.5	4700	9.2	8.6
	3		20.5	4800	9.4	8.6
	4		20.5	4800	9.3	8.6
Bramlette	1A	6/13/74				
	0		20.5	4900	5.8	8.6
	1		20.5	4900	6.4	8.6
	2		20.0	4800	5.9	8.6
	3		13.0	5200	6.4	8.4
	4		10.5	4900	6.0	8.4
	4.5		9.5	4800	3.4	8.2
	1B	6/13/74				
	0		22.0	5100	6.2	8.6
	1		22.0	5000	6.2	8.6
	2		22.0	5000	6.3	8.6
	3		16.0	5100	5.0	8.3
	4		12.5	5000	4.9	8.4
	5		10.0	5000	1.4	8.1
	5.5		9.0	5000	0.6	8.0
	1C	6/13/74				
	0		23.0	5100	5.2	8.6
	1		22.5	5000	5.8	8.6
	2		17.0	5000	3.5	8.3
	3		11.0	5000	5.2	8.4
	4		9.5	4800	2.4	8.2
	5		8.5	5100	-	7.9

Table 7 (con't)

Reservoir	Station No. and Depth (m)	Date	Temperature (C^0)	Conductivity µmhos/cm^2	Dissolved Oxygen (mg/l)	pH
Bramlette (con't)	2A	6/14/74				
	0		19.0	4900	7.0	8.6
	1		19.0	4900	7.0	8.6
	2		19.5	4900	6.9	8.6
	2B	6/13/74				
	0		21.0	5000	6.0	8.8
	1		21.0	5000	6.1	8.8
	2		20.0	4800	5.2	8.8
	3		14.0	5100	4.2	8.2
	2C	6/14/74				
	0		19.5	4900	6.9	8.6
	1		20.0	4900	6.8	8.6
	2		20.0	4900	6.5	8.6
	3		15.0	5100	5.2	8.3
	4		13.0	5100	4.8	8.2
	3A	6/14/74				
	0		20.5	5000	6.6	8.5
	1		20.0	5000	5.5	8.4
	2		20.0	5000	4.7	8.4
	2.5					
	3B	6/14/74				
	0		21.0	5000	6.1	8.5
	1		20.5	4900	4.9	8.5
	2		20.0	4800	3.4	8.4
	3		16.0	5400	0.0	7.6
	3C	6/14/74				
	0		22.5	5200	6.3	8.5
	1		22.0	5000	6.8	8.5

Table 7 (con't)

Reservoir	Station No. and Depth (m)	Date	Temperature	Conductivity µmhos/cm^2	Dissolved Oxygen (mg/l)	pH
Birkeland	1A	6/17/74				
	0		24.0	6300	7.7	8.7
	1		23.5	6200	7.4	8.7
	2		20.5	6800	12.4	8.5
	3		15.0	6200	7.2	8.5
	4		12.0	5800	5.6	8.4
	5		11.0	5800	3.3	8.4
	6		10.0	5800	2.5	8.4
	7		9.0	5800	0.0	8.3
	1B	6/17/74				
	0		25.0	6500	8.5	8.8
	1		24.0	6200	7.2	8.8
	2		20.0	6700	12.2	8.6
	3		16.0	6200	6.8	8.5
	4		13.0	6000	5.0	8.5
	5		11.0	5900	3.4	8.4
	6		10.0	6000	2.2	8.4
	7		9.0	5800	0.0	8.4
	8		8.5	5800	0.0	8.4
	9		8.0	5800	0.0	8.4
	1C	6/17/74				
	0		24.5	6200	8.1	8.8
	1		23.0	6100	7.6	8.8
	2		20.0	6600	12.8	8.6
	3		15.5	6300	6.7	8.5
	4		13.5	6200	5.2	8.5
	2A	6/18/74				
	0		22.0	6200	8.9	8.9
	1		22.0	6000	8.8	8.9
	2		19.0	5900	9.0	8.2

Table 7 (con't)

Reservoir	Station No. and Depth (m)	Date	Temperature	Conductivity μmhos/cm²	Dissolved Oxygen (mg/l)	pH
Birkeland (con't)	2B	6/18/74				
	0		22.0	6200	9.0	8.9
	1		22.0	6200	9.0	8.9
	2		19.0	6800	12.8	8.7
	2C	6/18/74				
	0		23.0	6200	8.3	8.9
	1		22.5	6200	8.2	8.9
	2		19.0	6800	12.7	8.7
	3		15.0	6400	7.1	8.6
	4		11.5	6200	3.4	8.5
	5		10.0	6000	0.1	8.4
	6		9.0	5800	0.0	8.4
	3	6/18/74				
	0		25.0	6500	8.5	8.9
	1		24.0	6300	9.1	8.9
	2		19.5	6800	12.8	8.7
	2.5		14.0	6400	3.4	8.6
	4	6/18/74				
	0		25.0	6600	7.1	8.9
	1		25.0	6400	6.6	8.9
Hanford	1	6/17/74				
	0		21.0	32000	5.1	8.4
	1		21.0	32000	5.2	8.4
	2		18.5	28000	4.5	8.1
	2	6/17/74				
	0		22.0	32000	4.8	8.4
	1		22.0	31000	4.8	8.4

TABLE 8

MONTANA SALINE SEEP
CHEMICAL ANALYSES
6/74

Reservoir	Station Number	Depth in Meters	Ammonia mg/l	NO_2+NO_3-N mg/l	TKN mg/l	Soluble P mg/l	Total P mg/l	TDS mg/l	Chloride mg/l	Sulfate mg/l	Sulfide mg/l
Tunis	2B	0	0.1	<0.1	1.6	0.06	0.09	382	12	192	0
		2.75	0.1	<0.1	1.5	0.11	0.11	373	12	221	0
Booth	1B	0	0.5	0.8	1.9	0.04	0.05	5160	61	3170	0
		3.5	0.1	0.8	1.7	0.04	0.08	5110	60	3250	0
	2B	0	0.2	0.7	1.9	0.04	0.06	5490	64	3550	0
		6	0.1	0.8	1.9	0.06	0.07	5680	67	3950	0
		10	0.9	0.6	2.2	0.06	0.09	5210	61	3020	0
	3B	0	1.0	0.6	1.9	0.02	0.07	5190	60	3260	0
	a	6	0.2	0.8	2.1	0.06	0.07	5470	63	3650	0
		9.5	0.4	0.6	2.1	0.02	0.08	5640	66	3900	0
	4B	0	0.7	0.6	2.2	0.02	0.06	5130	61	3500	0
		3.5	0.1	0.3	1.7	0.02	0.08	5210	60	3260	0
Bramlette	1B	0	0.6	8.4	3.6	0.09	0.09	5500	60	3950	0
		3	0.6	1.6	3.0	0.11*	0.06*	6540	71	5800	0
		5	1.2	4.6	3.8	0.12	0.12	7720	61	5780	0
	2B	0	0.8	8.6	3.6	0.05	0.09	5520	61	3880	0
		3	0.8	4.2	3.7	0.07	0.08	6400	71	4440	0
	3B	0	0.6	7.2	3.7	0.07	0.09	5540	61	3550	0
		2	0.8	6.8	3.7	0.05	0.09	5560	61	3450	0
		3	2.8	1.3	7.2	0.96	0.98	6550	71	4810	1.0
Birkland	1B	0	0.5	7.4	4.0	1.66	1.67	-	-	-	0
		2	1.0	1.3	4.1	1.42	1.26	7700	122	6020	0
		5	0.7	0.5	4.0	1.18	1.20	8540	133	6300	0
		9	3.6	0.4	4.9	1.24	1.36	8540	135	6160	4
	2C	0	0.4	8.4	4.5	1.7	1.74	6230	102	4740	0
		2	0.5	5.4	5.1	1.34	1.55	7680	123	5380	0
		4	1.0	0.5	4.5	1.46	1.50	8390	133	6190	0
		6	1.6	0.7	4.8	1.65	1.79	8420	133	6120	1.7
	4	0.75	1.0	4.6	4.6	1.62	1.64	6290	103	4350	0
Hanford	1	0	~2**	356	18.0	0.03	0.11	58100	305	45600	0
		2	~2**	356	18.0	0.05	0.12	57800	300	45700	0
Shonkon Creek			<0.1	<0.1	0.5	0.02	0.11	458	5	202	0
Highwood Creek			<0.1	<0.1	0.4	0.04	0.08	204	5	54	0

* Sample rerun with Total still less than soluble.
** Samples were run numerous times but interferences could not be overcome.

TABLE 9

MONTANA SALINE SEEP

TOTAL METALS SCAN (mg/l)

Reservoir or Stream	Tunis Reservoir		Hanford Reservoir		Shonkon Creek	Highwood Creek
Station No.	2B		1		1	1
Depth in Meters	0	2.75	0	2.0	-	-
Ni	<0.02	<0.02	<5.0	<5.0	<0.02	<0.01
Ca	20.0	20.0	400	400	20.0	8.0
Cr	<0.01	<0.01	<3.0	<3.0	<0.01	<0.008
Ba	0.04	0.03	<2.0	<2.0	0.07	0.02
Sn	<0.05	0.06	<5.0	<5.0	<0.07	<0.04
Mg	32.0	30.0	7400	7360	25.0	11.1
V	<0.04	<0.04	<10.0	<10.0	<0.05	<0.03
Mo	<0.006	<0.005	<2.0	<2.0	<0.007	<0.004
Ti	<0.03	<0.03	<1.0	<1.0	0.04	0.04
Li	0.03	0.02	0.7	1.0	<0.02	<0.008
As	<0.2	<0.2	<4.0	<4.0	<0.3	<0.2
Tl	<0.03	0.04	<10.0	<10.0	<0.04	<0.02
Al	<0.1	<0.1	<20.0	<20.0	1.0	0.7
Ga	<0.01	<0.01	<10.0	<10.0	<0.02	<0.01
Sr	0.3	0.3	8.0	8.0	1.0	0.3
Sm	0.3	0.3	<10.0	<10.0	<0.3	<0.2
Zn	<0.02	<0.02	<2.0	<2.0	<0.02	<0.01
Cd	<0.002	<0.002	<0.3	<0.3	<0.002	<0.001
Mn	0.006	0.06	<0.3	<0.3	<0.02	0.01
Fe	0.03	0.05	<1.0	<1.0	1.0	0.8
Pb	<0.07	<0.06	<1.0	<1.0	<0.08	<0.05
Be	<0.0003	<0.0003	<0.09	<0.1	<0.0004	<0.003
Sb	<0.02	<0.02	<5.0	<5.0	<0.02	<0.01
Cu	0.008	<0.005	<2.0	<1.0	<0.007	<0.004

TABLE 10

MONTANA SALINE SEEP
BOOTH RESERVOIR - 6/15 - 16/74

TOTAL METALS SCAN (mg/l)

Station No.	1B		2B			3B			4B	
Depth in Meters	0	3.5	0	6.0	10	0	6	9.5	0	3.5
Ni	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ca	200	200	100	200	100	200	200	200	200	100
Cr	<0.2	<0.2	<0.2	<0.3	<0.3	<0.2	<0.3	<0.3	<0.2	<0.2
Ba	0.6	<0.2	<0.2	0.8	<0.2	0.5	0.5	0.8	0.6	0.3
Sn	0.7	0.9	<0.4	0.9	<0.5	0.6	<0.4	0.7	0.8	0.6
Mg	290	290	300	310	320	300	310	340	310	300
V	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Mo	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Ti	0.2	0.2	<0.1	0.2	<0.1	0.2	0.2	0.2	0.2	0.2
Li	0.09	0.1	0.04	0.1	0.05	0.08	0.09	0.1	.08	0.07
As	<0.3	<0.3	<0.3	<0.3	<0.4	<0.3	<0.3	<0.4	<0.3	<0.3
Tl	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Al	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Ga	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Sr	3.0	3.0	2.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Sm	3.0	3.0	<1.0	4.0	<1.0	3.0	3.0	3.0	3.0	2.0
Zn	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Cd	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.04	<0.03	<0.03
Mn	0.1	0.2	0.1	0.4	0.5	0.1	0.4	0.7	0.1	0.1
Fe	<0.1	<0.1	<0.1	0.2	<0.1	<0.1	0.2	0.2	<0.1	0.2
Pb	2.0	<1.0	<1.0	2.0	<2.0	2.0	2.0	<2.0	2.0	2.0
Be	0.01	<0.009	<0.009	0.01	<0.009	0.01	0.01	<0.01	0.01	<0.009
Sb	<0.4	<0.4	<0.4	<0.4	0.5	<0.4	<0.5	<0.5	<0.4	<0.4
Cu	0.2	<0.1	<0.1	0.2	<0.2	0.2	0.2	0.2	0.2	<0.1

TABLE 11

MONTANA SALINE SEEP
BRAMLETTE RESERVOIR - 6/13 - 14/74

TOTAL METALS SCAN (mg/l)

Station No.	1B			2B		3B		
Depth in Meters	0	3	5	0	3	0	2	3
Ni	<0.5	<0.6	<0.7	<0.5	<0.7	<0.5	<0.5	<0.6
Ca	100	200	200	100	100	100	100	200
Cr	<0.3	<0.3	<0.3	0.3	<0.4	0.3	<0.3	<0.3
Ba	<0.2	0.7	0.5	0.5	<0.3	<0.2	0.3	<0.3
Sn	<0.5	1.0	<0.7	0.6	0.9	0.8	<0.5	0.9
Mg	560	670	720	560	690	550	580	660
V	<1.0	<2.0	<2.0	<1.0	<2.0	<1.0	<1.0	<2.0
Mo	<0.2	<0.3	<0.3	<0.2	<0.3	<0.2	<0.2	<0.3
Ti	<0.1	0.2	<0.2	0.1	<2.0	0.2	<0.1	<2.0
Li	0.1	0.3	0.2	0.2	0.1	0.2	0.2	0.2
As	<0.4	<0.5	<0.5	<0.4	1.0	<0.4	<0.4	<0.5
Tl	<1.0	<2.0	<2.0	<1.0	<2.0	<1.0	<1.0	<2.0
Al	<2.0	<3.0	<3.0	<2.0	<3.0	<2.0	<2.0	<3.0
Ga	<1.0	<1.0	<2.0	<1.0	<2.0	<1.0	<1.0	<1.0
Sr	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Sm	<1.0	2.0	<2.0	2.0	<2.0	2.0	<1.0	2.0
Zn	<0.2	<0.3	<0.3	<0.2	<0.3	<0.2	<0.2	<0.3
Cd	<0.04	<0.04	<0.05	<0.04	<0.05	<0.03	<0.03	<0.04
Mn	0.1	0.4	0.8	0.1	0.6	0.2	0.2	5.0
Fe	<0.1	<0.2	<0.2	<0.1	<0.2	0.2	<0.1	0.5
Pb	<2.0	4.0	<2.0	3.0	<2.0	2.0	2.0	3.0
Be	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Sb	<0.5	<0.6	<0.7	<0.5	0.8	<0.5	<0.7	<0.6
Cu	<0.2	0.2	<0.2	0.2	<0.2	<0.2	<0.2	<0.2

TABLE 12

MONTANA SALINE SEEP
BIRKLAND RESERVOIR 6/17 - 18/74
TOTAL METALS SCAN (mg/l)

Station No.	1B				2C				4
Depth in Meters	0	2	5	9	0	2	4	6	0.75
Ni	<0.6	<0.7	<0.3	<0.3	<0.2	<0.7	<0.8	<0.8	<0.2
Ca	100	100	200	300	200	100	200	100	200
Cr	<0.3	<0.4	<0.2	<0.2	<0.1	<0.4	<0.4	<0.4	<0.1
Ba	<0.3	<0.3	<0.1	0.3	<0.1	<0.3	<0.4	<0.4	<0.1
Sn	<0.6	<0.6	0.9	1.0	<0.7	<0.6	<0.8	<0.7	<0.7
Mg	500	580	660	690	490	580	680	700	500
V	<2.0	<2.0	<0.6	<0.6	<5.0	<2.0	<2.0	<2.0	<0.5
Mo	<0.3	<0.3	<0.09	<0.09	<0.07	<0.3	<0.4	<0.4	<0.07
Ti	<0.2	<0.2	<0.5	<0.5	<0.4	0.2	<0.2	<0.2	<0.4
Li	<0.2	0.2	0.3	0.8	0.6	0.3	0.3	0.1	0.4
As	<0.4	<0.5	<4.0	<4.0	<3.0	<0.3	<0.6	<0.6	<3.0
Tl	<2.0	<2.0	<0.5	<0.5	<0.4	<2.0	<2.0	<2.0	<0.4
Al	<3.0	<3.0	<2.0	<2.0	<2.0	<3.0	<3.0	<3.0	<2.0
Ga	<1.0	<2.0	<0.2	<0.2	<0.2	<2.0	<2.0	<2.0	<0.2
Sr	2.0	2.0	2.0	3.0	2.0	2.0	2.0	2.0	2.0
Sm	<2.0	<2.0	<4.0	5.0	<3.0	<2.0	<2.0	<2.0	<3.0
Zn	<0.2	<0.3	<0.2	<0.2	<0.1	<0.3	<0.3	<0.3	<0.1
Cd	<0.04	<0.05	<0.03	<0.03	<0.02	<0.05	<0.05	<0.05	<0.02
Mn	0.1	0.4	0.3	0.5	0.06	0.5	1.0	<0.7	<0.05
Fe	<0.2	<0.2	<0.2	<0.4	0.2	<0.2	<0.2	<0.2	<0.1
Pb	<2.0	<2.0	<1.0	3.0	2.0	<2.0	<2.0	<2.0	1.0
Be	<0.01	<0.01	<0.006	<0.006	<0.004	<0.01	<0.02	<0.02	<0.004
Sb	<0.6	<0.7	<0.3	<0.3	<0.2	<0.6	<0.8	<0.8	<0.2
Cu	<0.2	<0.2	<0.09	<0.1	<0.07	0.2	<0.2	<0.2	<0.07